

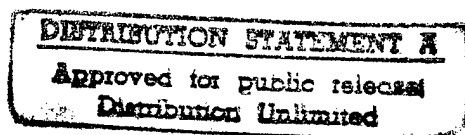
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Logistics Management Institute

Data Supporting the Screening Risk  
Assessment for the Pine Bluff Arsenal  
Chemical Demilitarization Facility

CE417RD2

William E. Legg



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Logistics Management Institute  
2000 Corporate Ridge  
McLean, Virginia 22102-7805

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# Data Supporting the Screening Risk Assessment for the Pine Bluff Arsenal Chemical Demilitarization Facility

## STUDY OBJECTIVES

The objectives of this study are to develop data element requirements and collection methods, collect the Phase I screening information and demographic information, analyze the Phase I data, and make recommendations about the use of the U.S. Environmental Protection Agency (USEPA) default values or derive appropriate default values for use.

## INTRODUCTION

### Background

The Pine Bluff Arsenal is a U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) facility located in Jefferson County, Arkansas; 30 miles southeast of Little Rock and eight miles northwest of Pine Bluff, Arkansas. The arsenal encompasses 14,956 acres of land, most of which (61 percent) is designated as open space/clearance zones. Most of this area is managed for forest products under the arsenal's timber management program. Approximately 21 percent of the facility supports the munitions supply and storage operations (18 percent conventional munitions, 3 percent chemical agent and munitions). Six percent of the facility contains the conventional munitions maintenance and production areas. The remaining 15 percent of the property is comprised of other administrative, operational, and housing areas along with the Food and Drug Administration's National Center for Toxicological Research. The arsenal has been in operation since 1941 and has been storing lethal unitary chemical agents since 1942. The arsenal is one of eight sites that stores lethal unitary agents in the United States.

In 1986, the Department of Defense Authorization Act was promulgated. It directed the destruction of the chemical agent munitions stockpiles by 30 September 1994. This act was amended in 1988 to allow for operational testing of a commercial-scale incineration project. The date for complete destruction of the stockpiles was extended to September 1997. On the basis of the results of an environmental impact statement, the chemical agent disposal method that appeared to provide the highest degree of safety and protection of human health and the environment was the on-site high-temperature incineration method. Thus, the chemical agent demilitarization program initiated design of the

incineration facilities and preparation of the required Resource Conservation and Recovery Act (RCRA) Part B permits for the hazardous waste incinerators.

In 1993, the U.S. Army Center for Health Promotion and Preventive Medicine, Provisional [USACHPPM(P)] was tasked by the U.S. Army Chemical Demilitarization and Remediation Activity (USACDRA) to perform multipathway human health risk assessments (HHRA) and ecological risk assessments (ERA) for the eight sites that store unitary chemical agents. The Logistics Management Institute (LMI) was requested to develop the screening-level risk analysis (SRA) data requirements for the Pine Bluff Arsenal (PBA) proposed site.

## Risk Assessment Requirements

The USEPA requires all RCRA Part B permit applications for hazardous waste incinerators to include a risk assessment (RA) that contains a multipathway HHRA and an ERA. Pursuant to the USEPA guidance, the RA uses a staged protocol that starts with a conservative SRA. The SRA is intended to provide the most conservative estimate of the potential risk, carcinogenic and noncarcinogenic, from direct exposures to combustion emissions and indirect exposures to contaminated soils, water sources, and food products. The SRA endpoints are estimates of individual risk for four specific exposure scenarios: a subsistence farmer, a subsistence fisher, an adult resident, and a child resident. For each scenario, the risk estimates are based on combining exposures and resultant risk for an individual contaminant of concern across several pathways. Where appropriate, risk from multiple contaminants of concern are also combined to provide overall estimates of risk for each exposure scenario. In the SRA for PBA, 83 contaminants are of concern for which risk estimates must be calculated. The USEPA screening guidance also provides default values for most of the input parameters used in the SRA calculations; but it allows the use of validated site-specific data to modify the values for the input parameters, especially in the situation where default values would constitute implausible scenarios. The USEPA's levels of acceptable risk for an SRA are as follows:

- ◆ One per 100,000 population exposed ( $1E-5$ ), plausible upper-bound estimate of the probability of an individual developing cancer as a result of a lifetime of exposure (70 years) to the modeled levels of carcinogenic emissions from the PBA hazardous waste incinerator. The modeled levels are based on trial burn emissions measurements taken at the Johnston Atoll chemical agent demilitarization facility.
- ◆ For noncarcinogenic systemic toxicants, the hazard quotient (HQ) (e.g., the ratio of the total daily oral intake to an established reference dose) for the contaminant of concern or, when appropriate, the hazard index (HI) (e.g., the sum of the HQs of contaminants in a mixture) should be less than 0.25. When HQs or HIs exceed unity (i.e., 1.0), there may be concern for potential adverse health effects.

Normally, the USEPA's acceptable level of carcinogenic risk is described as a risk range of one per 10,000 ( $1E-4$ ) to one per 1,000,000 ( $1E-6$ ) and the noncarcinogenic risk is any HQ or HI that does not exceed unity (i.e., 1.0). The levels proscribed for hazardous waste incinerator SRAs take into account that the unit may not be the only source contributing to exposures in the study area. Background exposure sources must be considered in order to avoid overestimation of allowable emissions levels, which could lead to unacceptable health risks to the public.

If the SRA results meet the acceptable risk criteria, then there is reason to conclude that further analysis of the risk from stack emissions is unnecessary. If the SRA results do not meet acceptable risk criteria, then phased demographic-specific (up to six levels) risk analyses must be completed. The phased risk analyses build increasing specificity into site data requirements only to the level required to verify compliance with the acceptable risk criteria. If none of the phased demographic-specific risk analyses meet the acceptable risk criteria, then the facility is denied the RCRA Part B permit.

## Screening-Level Risk Analysis Data Requirements

The SRA algorithms use a combination of USEPA default data values and site-specific data values. The USEPA default values are used in the air dispersion and contaminant deposition modeling; calculating media concentrations for each of the exposure pathways associated with indirect exposures; and determining fate, transport, and uptake parameters for specific chemicals of concern. The site-specific data collection and evaluation focuses on hydrogeological, topographical / terrain, meteorological, facility operational, emissions, and exposure assessment data. The site-specific data is confined to an area encompassed by a 50-kilometer radius circle about the operational facility. The USEPA requires that all default and site-specific data developed for use in an SRA be validated and referenced. The USEPA reserves the authority to dismiss any data values that it believes will lead to inappropriate estimates of risk. USACHPPM(P) and LMI personnel developed the data element requirements on the basis of a review of the USEPA guidance documents and their professional expertise in the risk assessment arena.

The screening-level data parameters primarily focus on the potential for indirect exposures to emissions from combustion sources; however, they directly relate to the amount of stack emissions that may be entrained in ambient air and, thus, is available for human/animal inhalation and human dermal absorption exposures. Their primary use is for the determination of fate and transport plus wet and dry deposition of the emissions products into surface waters, onto soils, and onto standing crops that constitute an indirect human/animal exposure pathway from the food chain.

Again, four human exposure scenarios are used in the SRA: a subsistence farmer, a subsistence fisher, an adult resident, and a child resident. These exposure scenarios differ primarily in the consumption rates of contaminated foods.

In the subsistence farmer exposure scenario, the farmer is exposed by consumption of homegrown beef, milk, and vegetables; incidental ingestion of soil; and direct inhalation of vapors and particulates. Site-specific exposure parameters and data should be used, where possible, to modify the basic default values and exposure scenarios in the effort to avoid unrealistic risk outcomes.

The subsistence fisher is exposed by consumption of contaminated fish, homegrown vegetables, incidental ingestion of soil, and direct inhalation of vapors and particulates. Site-specific fish consumption patterns should be used to avoid being overly conservative in this exposure scenario. The uptake of contaminants by above-ground and root vegetables is an especially critical element of both of the subsistence scenarios.

For both the adult and child resident scenarios, the exposures are consumption of homegrown vegetables, incidental soil ingestion, and the direct inhalation of vapors and particulates. The exposure parameters must be chosen carefully in the child resident exposure scenario in that the toxicity potential of the emissions products exert their effects over a 6-year exposure period rather than the 40-year exposure period used in the subsistence farmer scenario and the 30-year exposure period used in the subsistence fisher and adult resident scenarios.

## Data Collection Methods

The data were collected by reviewing numerous data sources and contacting specific Arkansas state, county, and municipal offices. Personnel contacted for the various data elements are listed with the applicable section of data. The list of data elements required was developed from the USEPA's *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions*, and its 1993a addendum; the *Revised Draft of Risk Assessment Implementation Guidance for Hazardous Waste Combustion Facilities*, USEPA 1994a; and the *Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes*, with all addendums such as USEPA 1994b, 1994c, 1994d, 1994e, and 1994f. We also developed a tabular array of the required data elements to facilitate data collection and to assist in data presentation (see Appendix).

## CONCLUSIONS

The data presented in this report and the data provided under separate cover were validated with local, state, and Federal personnel for accuracy and representative of the PBA area of concern.

# FINDINGS

## Sample Screening-Level Risk Analysis Calculations

We are providing a very simplified version of the risk assessment calculations found in a typical SRA. In the examples, we use one of the semivolatile contaminants of concern, tetrachlorodibenzo-(p)-dioxin (TCDD). We are also using the modeled exposure concentrations for TCDD as they were calculated for the SRA at PBA.

### INHALATION CHRONIC DAILY INTAKE ADULT RESIDENT

The chronic daily intake (CDI) is computed only for use in the linear low-dose cancer risk equation

$$CDI(mg/kg-day) = \frac{CA \times CF \times IR \times ET \times EF \times ED}{BW \times AT},$$

where

- CA = contaminant concentration in air in milligrams per meter cubed of air ( $mg/m^3$ ) =  $1.77E-11$  microgram ( $ug$ )/ $m^3$  TCDD computed from the USEPA air model; this value is also used as the exposure (E) value in the noncancer HQ formula;
- CF = conversion factor from  $ug/m^3$  to  $mg/m^3$  =  $1\text{ mg}/1,000\text{ ug}$ ;
- IR = inhalation rate [ $m^3$ /hour (hr)] =  $1\text{ m}^3/\text{hr}$  for an adult resident (i.e., the USEPA default value);
- ET = exposure time [hr/day (d)] =  $24\text{ hr}/\text{d}$  (i.e., the USEPA default value);
- EF = exposure frequency [d/year (yr)] =  $350\text{ d}/\text{yr}$  (i.e., the USEPA default value);
- ED = exposure duration (yr) =  $30\text{ yr}$  (i.e., the USEPA default value);
- BW = body weight in kilograms (kg) =  $70\text{ kg}$  (i.e., the USEPA default value); and
- AT = averaging time in days = 70-year lifetime for toxic effects (i.e.,  $70\text{ yr} \times 365\text{ d}/\text{yr}$ ) =  $25,550\text{ days}$ .

$$CDI (mg/kg-d) = \frac{(1.77E-11 ug/m^3)(1mg/1,000ug)(1m^3/hr)(24hr/d)(350d/yr)(30yr)}{(70kg)(25,550d)}$$

$$CDI (mg/kg-d) = \frac{(1.77E-14mg)(2.52E+05)}{(1.7885E+06kg-d)}$$

$$CDI = 2.49E-15(mg/kg-d).$$

#### LINEAR LOW-DOSE CANCER RISK

$$Risk = CDI \times SF,$$

where

$CDI$  = chronic daily intake averaged more than 70 years (mg/kg-d);

$SF$  = inhalation cancer slope factor of TCDD =  $1.16E+05 (mg/kg-d)^{-1}$ ; and

$Risk$  =  $2.49E-15 (mg/kg-d) \times 1.16E+05 (mg/kg-d)^{-1} = 2.89E-10$ . Conventionally, this number is rounded to the nearest whole number after completing the calculation. Therefore, the excess cancer risk due to emissions of TCDD =  $3.0E-10$  or three excess cancers per 10 billion persons exposed over a lifetime to this concentration of TCDD.

#### NONCANCER HAZARD QUOTIENT

The noncancer hazard quotient assumes that there is a level of exposure [i.e., reference dose (RfD) for oral exposures and reference concentration (RfC) for inhalation exposures] below which it is unlikely for even sensitive populations to experience adverse health effects. If  $E$  exceeds this threshold (i.e.,  $E/RfD$  or  $E/RfC$  exceeds unity), there may be concern for potential noncancer toxicity effects.

$$Noncancer HQ = E/RfC,$$

where

$E$  = exposure level =  $1.77E-11 ug/m^3$  as modeled for TCDD;

$RfC$  =  $3.50E-06 ug/m^3$  for TCDD, from the Integrated Risk Information System (IRIS). (This RfC for TCDD has been deleted from IRIS and is under review. It is used for example calculation purposes only.); and

$HQ$  =  $1.77E-11 ug/m^3 / 3.50E-6 ug/m^3 = 5.06E-6$  or 0.00000506.

## Data Element Requirements

The data element requirements list developed for use in the SRA for the PBA is as follows:

### PHASE I

#### *Screening Data Elements*

- ◆ Facility operational time period
- ◆ Average annual precipitation
- ◆ Average annual irrigation
- ◆ Average annual evapotranspiration
- ◆ Average annual surface runoff
- ◆ Universal soil loss equation rainfall or erosivity factor
- ◆ Total area for each body of water
- ◆ Impervious watershed area receiving deposition
- ◆ Total watershed area receiving deposition
- ◆ Average volumetric flow rate
- ◆ Depth of water column for each body of water.

#### *Exposure Assessment Data Elements*

- ◆ General
  - ▶ Site-specific body weight range
  - ▶ Monthly average air temperature
  - ▶ Sustained average wind speed, threshold wind speed
  - ▶ Types of produce grown in home gardens
  - ▶ Storm duration and length of time since previous rainfall
  - ▶ Number of people who fish and/or hunt

- ▶ Types of recreation: swimming, golfing, hiking, camping, biking, and all-terrain vehicular activities.
- ◆ Soil
  - ▶ Plow depth
  - ▶ Soil types: soil texture, bulk density, organic content percentage, field capacity, and wilting point
  - ▶ Unit soil loss: rainfall index, soil erodibility index, length-slope factor, support practice factor, and management practice factor
  - ▶ Fraction of vegetative cover for each land use.
- ◆ Plant tissue
  - ▶ Crop-specific information: crop productivity, harvest yield of the crop, and area planted to crop
  - ▶ Leafy vegetables: height of plant from the ground, radius of plants, number of plants per row, number of rows of plants, distance between plants in a row, and distance between rows of plants
  - ▶ Round and long produce: number of produce per unit area, radius of produce, length of long produce, and length and width of unit area
  - ▶ Fruits: number of fruits per unit area, length of long fruit, and radius of round fruit.
  - ▶ Length of growing season for each crop and produce item
  - ▶ Human daily ingestion of each produce group: leafy vegetables, above-ground protected produce, above-ground exposed round produce, above-ground exposed long produce, and below-ground produce.
- ◆ Animal tissue
  - ▶ Types of livestock: beef cattle, dairy cattle, pigs, sheep/goats, and chickens
  - ▶ Game animals that are consumed.
- ◆ Nursing infants
  - ▶ Number and location of breast-feeding mothers
  - ▶ Number of infants born per year.

## PHASE II

The data are used in the conduct of additional, more specific site health risk assessments, if the SRA fails to meet the USEPA screening criteria. The following data elements will be used in the more specific risk assessments. The data have been provided to the USACHPPM(P) under separate cover. The data can be summarized and presented in data base format when and if it is required.

- ◆ General

- ▶ Population centers: locations and numbers
- ▶ Locations of schools, nursing homes, and hospitals
- ▶ Major employers and locations
- ▶ Work schedule for employees within study area
- ▶ Exposure duration for civilian and military residents
- ▶ Current census information.

- ◆ Plant tissue

- ▶ Number and location of crop farms, truck patch farms, and orchards. also types of produce grown
- ▶ Ratio of produce grown within study area that is consumed versus exported
- ▶ Source and location of irrigation water for farms and home gardens
- ▶ Location of home gardens.

- ◆ Animal tissue

- ▶ Locations and numbers of livestock farms
- ▶ Numbers of livestock at each farm
- ▶ Livestock water source
- ▶ Percentage of grain and silage grown within study area versus the amount imported
- ▶ Ratio of grain and silage grown within study area used to feed livestock versus imported grain and silage

- ▶ Ratio of grain grown within study area fed to chickens versus amount of imported grain
- ▶ Amount of soil in grain and silage
- ▶ Average daily ingestion rate of grain, silage, and forage of each animal group
- ▶ Percentage of livestock that is consumed
- ▶ Ratio of livestock raised in the study area that is consumed versus imported
- ▶ Human daily ingestion rate of each animal group
- ▶ Human daily ingestion rate of each game animal
- ▶ Body fat percentage for each game animal.
- ◆ Surface water
  - ▶ Location, type, and use of body of water
  - ▶ Watershed delineation
  - ▶ Irrigation ditches: flow, average depth, and surface area
  - ▶ Percentage of stagnant surface water
  - ▶ Percentage of running surface water
  - ▶ Drinking water sources.
- ◆ Recreational
  - ▶ Locations of commercial and recreational fishing areas
  - ▶ Human daily ingestion rate of fish from area
  - ▶ Number of fish farms
  - ▶ Number of people who fish: subsistence and recreational fishers
  - ▶ Number of people who hunt and/or fish
  - ▶ Hunting location for each game animal
  - ▶ Recreation locations, recreation frequency, and recreation exposure time.

## RESULTS

This section provides the data documentation for the SRA. On the basis of the data collected and analyzed, we believe the data values presented below and in the Appendix should be used in the SRA for PBA.

### Screening Data Parameters

- ◆ Facility operational time period (USEPA default is 24 hours/day for a 30-year time period).
- ◆ Average annual precipitation (**P**) = 165.0 cm/yr (computed from Annual Climatological Summaries for Pine Bluff, Arkansas, obtained from Noel Risnychok, (704) 271-4800, National Climatic Data Center, Ashville, North Carolina, April 1995).
- ◆ Average annual irrigation (**I**) = 39.82 cm/yr (computed from modified Blaney-Criddle Consumptive Use Model data provided by Tony Stevenson, (501) 324-6641, U.S. Department of Agriculture, Natural Resources Conservation Service, Little Rock, Arkansas, May 1995).
- ◆ Average annual evapotranspiration (**Ev**) = 91.44 cm/yr (computed from Plate 13 data, Geraghty *et al*, *Water Atlas of the United States*, 1994).
- ◆ Average annual surface runoff (**R**) = 25.40 cm/yr (computed from Plate 21, Geraghty *et al.*, *Water Atlas of the United States*, 1994).
- ◆ Universal soil loss equation erosivity factor (**RF**) = 331.5 1/yr (averaged from the R values of the 10 counties of concern).
- ◆ Total surface area for each major body of water:
  - ▶ Arkansas River (**WA<sub>w</sub>**) =  $9.92\text{E} + 06 \text{ m}^2$  [computed based upon map planimeter measurement and average width data provided by Paul Brown, Corps of Engineers, Pine Bluff, Arkansas, (501) 534-0451].
  - ▶ Saline River (**WA<sub>w</sub>**) =  $2.07\text{E} + 06 \text{ m}^2$  [computed based upon map planimeter measurement and average width data provided by Cliff Roberts, Natural Resources Conservation Service, Saline County, Arkansas, (501) 778-3671].
  - ▶ Yellow Lake (**WA<sub>w</sub>**) =  $1.05\text{E} + 06 \text{ m}^2$  [computed based upon surface area of 260 acres. This data was provided by Charlie Becker, Natural Resources, PBA, (501) 540-2834].

- ◆ Impervious watershed area receiving deposition ( $WA_i$ ) =  $8.70E + 08 \text{ m}^2$  (computed based upon land use data contained in county soil surveys and 1993 *Arkansas Agricultural Statistics Report Series 327*).
- ◆ Total watershed area receiving deposition ( $WA_t$ ) =  $7.90E + 09 \text{ m}^2$  (which is the area of a 50-kilometer radius circle as required by the SRA).
- ◆ Average volumetric flow rate:
  - ▶ Arkansas River ( $V_{fx}$ ) =  $3.845E + 10 \text{ m}^3/\text{yr}$  (computed from data of hydrologic station 07263450, Arkansas River at Murray Dam at Little Rock, an average of 66 years worth of data).
  - ▶ Saline River ( $V_{fx}$ ) =  $2.38E + 09 \text{ m}^3/\text{yr}$  (computed from data of hydrologic station 07363500, Saline River near Rye, an average of 55 years worth of data).
  - ▶ Yellow Lake ( $V_{fx}$ ) =  $1.28E + 06 \text{ m}^3/\text{yr}$ . (The actual flow rate of the lake is intermittent and negligible per Charlie Becker, Natural Resources, PBA. The USEPA guidance requires that the minimum volumetric flow rate for a lake must equal the mean lake volume per page 9-7, *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions*, Interim Final, USEPA/600/6-90/003, January 1990.)
- ◆ Depth of water column for each body of water:
  - ▶ Arkansas River ( $d_w$ ) = 3.2 m (based upon information provided by Paul Brown, Corps of Engineers, Pine Bluff, Arkansas).
  - ▶ Saline River ( $d_w$ ) = 1.98 m (based upon information provided by Cliff Roberts, Natural Resources Conservation Service, Saline County, Arkansas).
  - ▶ Yellow Lake ( $d_w$ ) = 1.22 m (based upon information provided by Charlie Becker, Natural Resources, PBA).

## Phases I and II Exposure Assessment Parameters and Data Values

### BODY WEIGHT RANGES

Children ages 1 to 6, 15 kg; adults, 70 kg; infants, age <1 year, <11 kg. Data extracted from USEPA's *Exposure Factors Handbook (EFH)*, risk-assistant exposure-assessment scenarios background defaults. Data is used in exposure uptake formulas and in Phase II to identify risk-based subpopulations.

## MONTHLY AVERAGE AIR TEMPERATURE AND STORM EVENT DATA

Data was provided to the USACHPPM(P) under separate cover from the National Climatic Data Center, Climate Services Division (based upon Pine Bluff and Little Rock data stations): 10 years worth of data plus analyses for average air temperature, average storm event, and maximum storm event. Data is used in primary plume modeling: soils uptake, crop uptake of contaminants, soil erosion and runoff to surface waters, and body of water contamination formulas.

## SUSTAINED AVERAGE WIND SPEED AND DIRECTION; THRESHOLD WIND SPEED

Data was extracted from environmental impact statement (EIS) analysis completed by USACDRA, October 1994. Data is used in primary plume modeling.

## HUNTING AND FISHING DATA

Data was provided under separate cover.

### *Hunting*

Hunting data summary is provided by the Arkansas Game and Fish Commission. LMI extracted the total number of licensed hunters for each county from data provided in the Arkansas Game and Fish Commission's license sales summary computer data. We also derived the amount of deer tissue ingested for each hunter/family: = 41.91 lbs/yr, or 19.01 kg/yr. Based upon the EFH average consumption values of 100 grams/meal  $\times$  4 persons eating/meal; and an reasonable maximum exposure (RME) consumption rates of 280 grams/meal  $\times$  4 persons eating/meal, the total meals eaten (T) is  $T_{100} = 47.52$  meals/yr and  $T_{280} = 16.97$  meals/yr. Meals/yr = event/yr, which is used in the exposure intake formulas. The fraction contaminated (FC) based upon substituting deer tissue consumed for beef consumed in a year is  $FC_{100} = 47.52/350 = 0.14$  and  $FC_{280} = 26.31/350 = 0.02$ ; this last value would constitute an RME for the average hunter's family. For a subsistence hunter,  $FC = 0.75$ , which is the EFH's default for beef consumption and simply reflects that the individual subsisting on home-grown beef is not anticipated to consume 100 percent contaminated products. The total deer intake for subsistence hunters should be set at the harvest figure of 19.01 kg. Although the USEPA risk methodology requires that the subsistence hunter exposure scenario be considered, the Arkansas harvest statistics for deer do not indicate the presence of subsistence hunting.

We recommend that the FC values and intakes presented above be used as demographic-specific values for the PBA risk assessment. This data will be used in various exposure scenarios and exposure intake formulas in the assessment. Information on other big game and small game hunting statistics was not available from the Arkansas Game and Fish Commission. We consider the overall

game harvest statistics to be insufficient to draw conclusions concerning subsistence hunting for any species other than deer. Arkansas does not provide data on days spent in pursuit of game. Data was extracted from the *Arkansas 1994 – 1995 General Hunting and Wildlife Management Area Regulation Guide* to establish the maximum number of days that a hunter could be exposed while deer hunting. Assuming that a deer hunter hunted each day, the hunter's maximum number of exposure days would occur during the archery/crossbow seasons and would total 151 days.

### *Fishing*

The Arkansas Game and Fish Commission's Creel data is insufficient to establish an area-specific consumption rate. The total number of licensed fishermen in the 10 counties is 81,766 for resident licenses and 569 for commercial licenses. The sum of the average weight of fish caught in PBA-area lakes in grams/angler/hour = 603.27. The total weight, in grams/yr, of fish caught by commercial fisherman in the PBA area =  $9.75E + 06$  grams/yr. We recommend use of 13.0 grams/person/day for the average consumption rate, and 38.4 grams/person/day for the RME consumption (subsistence fisherman) rate for use in the SRA for PBA. These rates are found in the *EFH*, Table 2-15, East South Central Census Region, page 2-34.

### TYPES OF PRODUCE GROWN IN HOME GARDENS

The default list was provided. For ingestion rates, LMI recommends using *EFH* default values listed in Tables 2-6, 2-7, 2-9, and 2-10 of the *EFH*. This method allows use of the Arkansas County Census Data to derive the number of gardens per county using the *EFH* default of 33 percent for the south. Several exposure uptake and scenarios use this information for calculating residual risk.

### TYPES OF RECREATION BY COUNTY

Data were obtained from the EIS and the Arkansas Game and Fish Commission. The only park within the study area is Toltec Mounds State Park in Lonoke County. The data for the risk assessment mainly pertains to fishing and hunting; but, they also include inhalation exposures and dermal exposures while swimming. Data were provided on the basis of the number of user days/annum/park within the study area. With the use of the default data for recreation found in Tables 5-5 through 5-9 of the *EFH*, exposure durations for the swimming events may be calculated for the various age groups and exposure scenarios. The hunting and fishing days for exposure were provided as noted in the hunting and fishing data above.

## SOILS DATA

Soils data books for each county within the 50 kilometer radius circle were obtained from the Arkansas Natural Resources Soil Conservation Service in each county. The soils types for each county were analyzed for central tendency values for K values (i.e., erosion factor), length-slope values, organic matter percentage, and moist bulk density (using the first soil layer only 1 to 20 centimeters, 0.4 to 8 inches). These values are used in formulas for wet and dry deposition of contaminants in soils, plant uptake of contaminants, and soils contamination of surface bodies of water. The land use values were computed based on data found in the county soils data books and the *Arkansas Agricultural Statistics Report Series 327*. The computed values for the region are forested land = 49.67 percent, agricultural land = 39.35 percent, and other land use = 10.98 percent. LMI recommends that only the agricultural and pasture percentages be subjected to the crop contaminant portions of the risk assessment and the erosion equations. The forests are essentially protected crops and are not subject to high erosion potential or wet/dry deposition rates of the contaminants.

## VEGETATIVE COVER

The data (as discussed above) are as follows:

- ◆ Total area in 50-kilometer radius =  $7.90\text{E} + 09 \text{ m}^2$
- ◆ Forest = 49.67 percent =  $3.92\text{E} + 09 \text{ m}^2$
- ◆ Agriculture = 39.35 percent =  $3.11\text{E} + 09 \text{ m}^2$
- ◆ Other = 10.98 percent =  $8.70\text{E} + 08 \text{ m}^2$

## EROSION DATA

Discussed under the "Soils Data" subsection above.

## PLANT TISSUE

The data were provided from the *Arkansas Agricultural Statistics Report Series 237* (1993), and from the EIS section on community resources. The major crops are listed by county along with the crop yields, number of producing farms, etc. The vapor transfer of contaminants to plant tissues seems to be a driver in the risk assessment. Therefore, some of the planting practices data are required to calculate risks. The human daily ingestion data will use the default

data from *EFH* Tables 2-6 through 2-10. The major agricultural plants for the study region are the following:

◆ Corn

- ▶ Plants/acre = 20,000
- ▶ Rows/acre = 83.5
- ▶ Plants/row = 239.5
- ▶ Height of plant = 6.5 ft
- ▶ Radius of plant = 1.5 ft
- ▶ Distance between plants = 10.44 in.
- ▶ Distance between rows = 2.5 ft
- ▶ Yield/acre = 107.34 bushels (bu)/acre (a)  $\times$  25.4 kg/bu = 2,726.4 kg/a  $\div$  4.047 m<sup>2</sup>/a = 0.6737 kg/m<sup>2</sup>
- ▶ Length of growing season = 210 days

◆ Soybeans

- ▶ Plants/acre = 104,542
- ▶ Rows/acre = 83.5
- ▶ Plants/row = 1,252
- ▶ Height of plant = 2.5 ft
- ▶ Radius of plant = 10 in.
- ▶ Distance between plants = 2.0 in.
- ▶ Distance between rows = 2.5 ft
- ▶ Yield/acre = 27.94 bu/a  $\times$  25.4 kg/bu = 709.68 kg/a  $\div$  4.047 m<sup>2</sup>/a = 0.1754 kg/m<sup>2</sup>
- ▶ Length of growing season = 210 days

◆ Wheat

- ▶ Plants/acre = 1,558,746

- ▶ Rows/acre = 417
- ▶ Plants/row = 3,738
- ▶ Height of plant = 2.5 ft
- ▶ Radius of plant = 4.5 in.
- ▶ Distance between plants = 0.67 in.
- ▶ Distance between rows = 6.0 in.
- ▶ Yield/acre = 44 bu/a  $\times$  27.1 kg/bu = 1,203.2 kg/a  $\div$  4.047 m<sup>2</sup>/a = 0.2973 kg/m<sup>2</sup>
- ▶ Length of growing season = 210 days

◆ Sorghum

- ▶ Plants/acre = 52,271
- ▶ Rows/acre = 83.5
- ▶ Plants/row = 626
- ▶ Height of plant = 3.0 ft
- ▶ Radius of plant = 1.5 ft
- ▶ Distance between plants = 4.0 in.
- ▶ Distance between rows = 2.5 ft
- ▶ Yield/acre = 66.35 bu/a  $\times$  27.1 kg/bu = 1,798.1 kg/a  $\div$  4.047 m<sup>2</sup>/a = 0.4443 kg/m<sup>2</sup>
- ▶ Length of growing season = 210 days

◆ Rice

- ▶ Plants/acre = 385,770
- ▶ Rows/acre = 385
- ▶ Plants/row = 1,002
- ▶ Height of plant = 20 in.
- ▶ Radius of fruit = 3.75 in.

- ▶ Distance between plants = 2.5 in.
  - ▶ Distance between rows = 6.5 in.
  - ▶ Yield/acre =  $2,312 \text{ kg/a} \div 4.047 \text{ m}^2/\text{a} = 0.5713 \text{ kg/m}^2$
  - ▶ Length of growing season = 224 days
- ◆ Cotton
- ▶ Plants/acre = 20,658
  - ▶ Rows/acre = 66
  - ▶ Plants/row = 313
  - ▶ Height of plant = 52 in.
  - ▶ Radius of plant = 19 in.
  - ▶ Distance between plants = 8.0 in.
  - ▶ Distance between rows = 38 in.
  - ▶ Yield/acre =  $274 \text{ kg/a} \div 4.047 \text{ m}^2/\text{a} = 0.0677 \text{ kg/m}^2$
  - ▶ Length of growing season = 234 days
- ◆ Oats
- ▶ Plants/acre = 385,770
  - ▶ Rows/acre = 385
  - ▶ Plants/row = 1,002
  - ▶ Height of plant = 3.0 ft
  - ▶ Radius of plant = 3.75 in.
  - ▶ Distance between plants = 2.5 in.
  - ▶ Distance between rows = 6.5 in.
  - ▶ Yield/acre =  $85 \text{ bu/a} \times 18.1 \text{ kg/bu} = 1,538.5 \text{ kg/a} \div 4.047 \text{ m}^2/\text{a} = 0.3802 \text{ kg/m}^2$
  - ▶ Length of growing season = 185 days.

## ANIMAL PRODUCTS

The data were provided in the *Arkansas Agricultural Statistics Report Series 327* and the EIS section on community resources. The consumption factors from the *EFH* will be used to calculate average daily intake and lifetime average daily intake values. The data for the huntable species were derived by LMI. The USACHPPM(P) is advised to apply contaminant uptake concentrations to game animals by calculating uptake rates for 49.67 percent forested areas + 39.25 percent agricultural areas to daily food intakes of the game animals.

## BREAST MILK

The data were provided to USACHPPM(P) by the county on the birth rates for the last 10 years and the percentage of mothers who breast-fed their babies. There data were obtained from Arkansas' Women, Infants, and Children program. The breast-milk contamination scenarios should be limited to an exposure duration of one year.

## PERCENTAGE OF GRAIN AND SILAGE GROWN WITHIN THE STUDY AREA VERSUS IMPORTED

<i>Grown</i>	<i>Imported</i>
grain = 2.0 percent	grain = 98.0 percent
silage = 1.7 percent	silage = 98.3 percent

## RATIO OF GRAIN AND SILAGE GROWN WITHIN THE STUDY AREA USED TO FEED LIVESTOCK VERSUS IMPORTED GRAIN AND SILAGE

<i>Grown and Fed</i>	<i>Imported and Fed</i>
grain = 2.3 percent	grain = 97.7 percent
silage = 2.0 percent	silage = 98.0 percent

## RATIO OF GRAIN GROWN WITHIN THE STUDY AREA FED TO CHICKENS VERSUS IMPORTED GRAIN

<i>Grown and Fed</i>	<i>Imported and Fed</i>
grain = 0.0 percent	grain = 100.0 percent

## AMOUNT OF SOIL IN GRAIN AND SILAGE

Zero percent for both.

## RATIO OF LIVESTOCK RAISED IN THE STUDY AREA THAT IS CONSUMED

For cattle and calves, 4.5 percent are consumed in the area and 95.5 percent are exported. For hogs, 5.3 percent are consumed in the area and 94.7 are exported. For poultry, 0.3 percent are consumed in the area and 99.7 percent are exported.

## OTHER

Other demographic-specific data pertaining to population centers, locations of schools, nursing homes, hospitals, major area employers, and current census information was extracted from the EIS and the Arkansas County Census Data and was provided under separate cover to the USACHPPM(P).

## RECOMMENDATIONS

We recommend the following:

- ◆ Use the data provided in this report and the data provided under separate cover as the basis for completing the SRA for PBA.
- ◆ If further data specificity is required for these data elements, site visits at PBA may be required.

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## APPENDIX

# Data Tables

# Tables

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**Table A-1.**  
**Risk Assessment Information — Pine Bluff Arsenal**  
**(General)**

Data elements	Potential data sources	Completed?
<i>Body weight ranges</i> Infants: 1 to 6 yrs, 15 kg Adults: 70 kg Babies: < 1 yr, < 11 kg	<i>Exposure Factors Handbook (EFH)</i> , EPA/600/8-89/043, March 1989, Table 5-2 (adults); Appendix 5A, Tables 5A-3, 4 (averaged 95 percent weight for infants < 1yr); <i>Human Health Evaluation Manual, Supplemental Guidance</i> , March 1991, p. 15, children's weight and age 1 to 6 yrs	Yes
<i>Monthly average air temperature, ° F, by month for 10 yrs</i> January: 39.7 February: 45.5 March: 54.2 April: 60.1 May: 71.0 June: 78.2 July: 81.2 August: 80.4 September: 73.8 October: 63.6 November: 53.1 December: 43.3	National Climatic Data Center (NCDC): Noel Risnychok (704) 271-4800, ext. 163	Yes
<i>Wind information</i> Sustained average wind speed: 8.7 meters per second (m/s) Sustained common wind direction: SSW, NNE, N Threshold wind speed: 0.0 m/s	Environmental impact statement (EIS); NCDC information indicates yearly average wind speed of 3.49 m/s from SW direction  EIS; EPA Risk Guide for Combustors	Yes  Yes
<i>Storm Information</i> Average rainfall event: 0.206 in./day Maximum rainfall event: 7.96 in./day	NCDC information (see above)	Yes

**Table A-2.*****Risk Assessment Information — Pine Bluff Arsenal  
(Fishing and Hunting)***

Data elements	Potential data sources	Completed?
<i>Fishing</i> No. of licensed fishermen by co. Length of the fishing season Average no. of fishing days Average catch per fisherman <i>Counties</i> Jefferson Grant Saline Pulaski Lonoke Prarie Arkansas Lincoln Cleveland Dallas <i>Major fish species</i> Black bass Saltwater striper Walleye White/yellow bass Hybrid stripe bass Bream Rainbow trout Alligator gar Crappie	Jean Risinger — Arkansas Game and Fish Commission (501) 223-6425  John Sunderland — Fisheries Department (501) 223-6320	Yes

**Table A-3.**  
**Risk Assessment Information — Pine Bluff Arsenal**  
**(Hunting)**

Data elements	Potential data sources	Completed?
No. of licensed hunters by co. Length of the hunting season by species Average no. of hunting days Average harvest by species <i>Counties</i> Jefferson Grant Saline Pulaski Lonoke Prarie Arkansas Lincoln Cleveland Dallas <i>Hunting species</i> Deer Hogs Turkey Squirrels Quail Dove Rabbit <i>Waterfowl</i> Duck Goose Rails Snipe <i>Other</i> Racoon Opossum Coyote	Jean Risinger — Wildlife Management (501) 223-6300	Yes

**Table A-4.**  
**Risk Assessment Information — Pine Bluff Arsenal**  
**(Produce)**

Data elements	Potential data source	Completed?
Types of produce grown in home gardens (applies to all Arkansas counties in gDW/kg BW/day).	Brenda Cheltam, State Agricultural Service (501) 324-5145. <i>Arkansas Agricultural Statistics Report Series 327. EFH</i> Table 2-10, (p. 2-19), values for 50th percentile.	Yes
<i>Area produce</i>	<i>Consumption rate in grams/day (g/d)</i>	
Corn	60.90 g/d	
Lima beans	21.80 g/d	
Green beans	15.10 g/d	
Tomatoes	14.60 g/d	
Cucumbers	9.10 g/d	
Grains	2.40 g/d	
Legumes	0.68 g/d	
Potatoes	0.35 g/d	
Root vegetables	0.037 g/d	
Fruit	0.33 g/d	
Fruiting vegetables	0.13 g/d	
Leafy vegetables	0.02 g/d	
	Refer to <i>EFH</i> for child and infant consumption data	

**Table A-5.*****Risk Assessment Information — Pine Bluff Arsenal  
(Types of Recreation by County)***

Data elements	Potential data sources	Completed?
National Parks and State Parks of Arkansas: 1 State Park in the area of concern with numbers of visitors/year:	Arkansas Department of Recreation (Parks and Tourism) [Nancy Clark — (501) 682-7777]	Yes
Toltec Mounds State Park, Lonoke County — Approximately 23,500 visitors/year. Archeological site walking tour and by tram (when available)	No. of national parks within a 30-mile radius of the arsenal	Yes

**Table A-6.****Risk Assessment Information — Pine Bluff Arsenal  
(Soil Data)**

Data elements	Potential data sources	Completed?
<p><i>Soil types</i></p> <p>Provide the average value for all soils in the counties of concern for the following parameters:</p> <p>Moist bulk density (g/cm<sup>3</sup>) = 1.55</p> <p>Organic contents (percentage) = 1.11</p> <p>Slope length factor (LS) = 0.55</p> <p>Erosion factor (tons/acre) (k) = 0.35</p> <p>Erosivity factor (1/yr) (R) = 331.5</p> <p><i>Vegetative cover</i></p> <p>The fraction of vegetative cover for each of the following land uses:</p> <p>Total area in 50 Km radius = 7.9E+9m</p> <p>Forest , 49.67% = 3.92E + 09 m<sup>2</sup></p> <p>Agriculture , 39.35% = 3.11E + 09 m<sup>2</sup></p> <p>Other, 10.98% = 8.70E + 08 m<sup>2</sup></p> <p><i>Erosion data</i></p> <p>Average annual runoff (cm/yr) = 25.40 cm.</p> <p>Soil mixing depth (cm) = 20 cm</p> <p><i>Surface water data</i></p> <p>Water resources in the area: lakes, streams, rivers</p> <p>Surface area of water resources</p> <p>Volumetric flow rates of water resources</p> <p>Depth of water column of water resources</p>	<p>Arkansas State Geological Service (501) 663-9714. U.S. Department of Agriculture, Soil Conservation Service, Soils Survey reports for the counties of concern</p> <p>Data computed from <i>Soils Surveys and Arkansas Agricultural Statistics Report Series 327</i></p> <p>Gerhaghty <i>et al.</i>, 1973</p> <p>EPA's default for plow depth</p> <p>Provided under separate cover</p> <p>Provided under separate cover</p> <p>Provided under separate cover</p>	<p>Yes</p>

**Table A-7.****Risk Assessment Information — Pine Bluff Arsenal  
(Plant Tissue)**

Data elements	Potential data sources	Completed?
<p>Crop-specific information for each major commercial crop grown in the state. Major crops are corn, soybeans, wheat, sorghum, rice, cotton, and oats.</p> <p>Establish the major fruit and vegetable crops (also, see above for common crops)</p> <p><i>Crop productivity</i></p> <p>bushels/acre</p> <p><i>Harvest yield</i></p> <p>mass/area</p> <p><i>Area planted to crop acres</i></p> <p>Standing crop biomass kilograms dry weight per meter squared</p> <p><i>Specific information on each crop species</i></p> <p><i>Leafy vegetables</i></p> <p>Height of plant (cm)</p> <p>Radius of plant (cm)</p> <p>Planting practice</p> <p>Plants per row</p> <p>Rows per acre</p> <p>Distance between plants (cm)</p> <p>Distance between rows (cm)</p> <p>Length of growing season (days)</p> <p><i>Round and long produce</i></p> <p>Planting practices</p> <p>Number per unit area (yield)</p> <p>Radius of round produce (cm)</p> <p>Length of long produce (cm)</p> <p>Width of long produce (cm)</p> <p><i>Fruits</i></p> <p>Planting practices</p> <p>Number per unit area (yield)</p> <p>Length and width of long fruit (cm)</p> <p>Radius of round fruit (cm)</p>	<p>Brenda Anderson, Arkansas State Department of Agriculture, (501) 671-2000, will send current Agricultural Statistics book — this information should be included in the book.</p> <p>The USACHPPM(P) was provided with data compiled from the <i>1993 Arkansas Agricultural Statistics Report Series 327</i>. Additional data was provided by agronomist Harry Ferris with the Arkansas State Department of Agriculture</p>	Yes

**Table A-8.**  
**Risk Assessment Information — Pine Bluff Arsenal**  
**(Human Daily Ingestion)**

Data elements	Potential data sources	Completed?
<p><i>Crops</i></p> <p>Segregated as shown below for each commercially grown crop:</p> <p>Leafy vegetables</p> <p>Above-ground protected produce</p> <p>Above-ground exposed round produce</p> <p>Above-ground exposed long produce</p> <p>Below-ground produce</p> <p><i>Animal products</i></p> <p>These are the major commercial animal products produced in Arkansas:</p> <p>Cattle and calves</p> <p>Hogs</p> <p>Poultry</p> <p><i>Animals that are hunted</i></p> <p>Deer</p> <p>Hogs</p> <p>Turkey</p> <p>Squirrels</p> <p>Quail</p> <p>Dove</p> <p>Rabbits</p> <p><i>Waterfowl</i></p> <p>Duck</p> <p>Goose</p> <p>Rails</p> <p>Snipe</p> <p><i>Other</i></p> <p>Raccoon</p> <p>Opossum</p> <p>Coyote</p>	<p>See <i>EFH</i> it provides information on percentage of crops that people eat that they grow. Recommend use of exposure factors from the <i>EFH</i> on amounts of each meat and vegetable consumed. Use the appropriate screening-level risk analysis formula to calculate the amount of contaminant ingested.</p> <p>County Extension Agent/Services were contacted and asked the following questions:</p> <p>a. How much of each animal produce is raised in the county?</p> <p>b. Of the amount raised in the county, how much is consumed within the county?</p> <p>c. How much of that raised is exported and to where is it exported?</p>	<p>Yes</p>

**Table A-9.**  
***Risk Assessment Information — Pine Bluff Arsenal***  
***(Birth Rates and Breast-Feeding)***

Data elements			Potential data sources	Completed?
Breast Milk — Percentage of infants that are breast-fed.			Arkansas Department of Health, Records, (501) 661-2369, Carol Nellis	Yes
Birth rate				
<i>1993 data</i>	<i>Avg. birth/yr</i>	<i>Birth rate percentage</i>		
Jefferson	1,348	16.0		
Arkansas	290	13.8		
Prarie	91	9.7		
Lonoke	583	14.2		
Pulaski	5,719	16.3		
Saline	838	12.3		
Grant	190	13.2		
Dallas	134	14.3		
Cleveland	88	11.2		
Lincoln	170	12.3		

**Note:** Private sector — 50 percent breast-feed at delivery; at 6 weeks, about 30 percent. Only the Women, Infants, Children population-only, 9 percent breast-feeding at any given time.

# REPORT DOCUMENTATION PAGE

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